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SID 62-99-28

FOR THE APOLLO SPACECRAFT

CONTRACT NAS 9-150

55 (U)

PARAGRAPH 8.10 EXHIBIT I

1 JUNE 1964

Prepared By

WEIGHT CONTROL

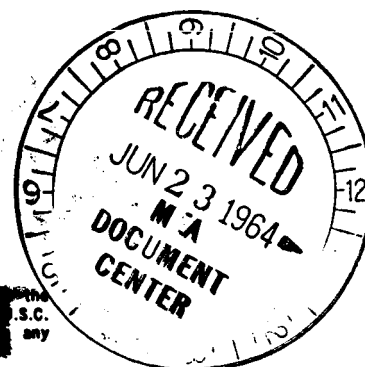
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**NORTH AMERICAN AVIATION, INC.**  
**SPACE and INFORMATION SYSTEMS DIVISION**



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~~CONFIDENTIAL~~INTRODUCTION

The June report will be the last report to utilize the current Airframe 011 drawing release as a basis. In future reports Airframe 012 will be utilized as it is potentially the first manned flight. The current weight status summarizes the changes from the previous Airframe 011, and incorporates the estimated changes for the LOR Mission Spacecraft. This format allows weight status reporting consistent with airframe release and continuous updating of the estimated LOR changes. The Detail Weight Statement has been modified to include a column for Airframe 011 as well as the LOR spacecraft. The potential changes section includes pending current design changes as well as preliminary estimates for the Block II configuration.

The current report reflects a LOR spacecraft decrease of 45 pounds at injection and 20 pounds at the injected spacecraft condition less Service Module propellant. The current injected weight of 90,070 pounds is based on Service Module propellant loading for a specific impulse of 313.0 seconds, and  $\Delta V$  budget of the MSC Letter PE 5-64-78, dated approximately 11 February 1964, subject Contract NAS 9-150, Velocity Budget, Target Weight and Mission Plans. This is based on a lunar excursion module of 29,500 pounds, excluding crew.

The major changes in the LOR Command Module were due to a decrease in the scientific equipment and increases in structure due to honeycomb bonding specification, crew couches based on new crew acceleration limits, crew system useful load item based on revised GFE weights.

The major change in the Launch Escape System was due to a decrease in tower insulation based on refined boost heating rates.

The Earth Orbital Mission Weight Summary reflects a two state Booster-to-Orbit injection without the use of Service Module propulsion and is based on a complete Service Module with 2,430 pounds of deorbit propellant. The Earth Orbit weight reported limits the orbital altitude capability with the Saturn I booster to 60.4 nautical miles. To obtain the 100 nautical mile orbital altitude with the Saturn I booster requires offloading items from the Command Module and Service Module.

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APOLLO LOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT. <sup>2</sup> )		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10030	1043.5	-0.5	5.8	4753	4195	3888
SERVICE MODULE - Less Propellant	10120	907.0	0.6	-0.3	6471	10654	10535
TOTAL - Less Propellant	20150	974.9	0.1	2.7	11266	35148	34803
PROPELLANT - S/M**	36945	902.4	6.0	-2.5	18954	19307	25753
TOTAL - With Propellant	57095	928.0	3.9	-0.7	30396	69343	75467
LUNAR EXCURSION MODULE	29500	588.5	-0.5	-0.3	19409	21485	21219
ADAPTER - LEM - C-5	3475	657.0	0.0	0.0	8504	11778	11778
TOTAL - Injected	90070	806.4	2.5	-0.4	58380	603905	609830
LAUNCH ESCAPE SYSTEM	7510	1306.6	0.0	0.0	287	14718	14719
TOTAL - SPACECRAFT LAUNCH	97580	844.9	2.3	-0.4	58676	993051	998986

NOTES: \*Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the Command Module substructure mold line.

\*\*The propellant weight of 36945 pounds is determined from an estimated time line analysis. The propellant weight is based on a specific impulse of 313.0.

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APOLLO EARTH ORBIT MISSION  
WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT <sup>2</sup> )		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10030	1043.5	-0.5	5.8	4753	4195	3888
SERVICE MODULE - Less Propellant	10120	907.0	0.6	-0.3	6471	10654	10535
TOTAL - Less Propellant	20150	974.9	0.1	2.7	11266	35148	34803
PROPELLANT - S/M**	2430	849.2	27.3	-11.5	809	427	546
TOTAL - With Propellant	22580	961.4	3.0	1.2	12517	43071	43098
ADAPTER - C-1	885	778.5	-0.3	-0.5	1058	868	820
TOTAL - Injected	23465	954.5	2.9	1.1	13578	50090	50070
LAUNCH ESCAPE SYSTEM	7510	1306.6	0.0	0.0	287	14718	14719
TOTAL - Spacecraft Launch	30975	1039.9	2.2	0.9	13876	217034	217023

NOTES: \*Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

\*\*The earth orbital weights are based on a complete service module and includes 2430 pounds of propellant for an orbital altitude of about 60.4 nautical miles with a payload launch azimuth of 72°.

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APOLLO LAUNCH ABORT CONFIGURATION  
WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT <sup>2</sup> )		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10030	1043.5	- .5	5.8	4753	4195	3888
LAUNCH ESCAPE SYSTEM	7510	1306.6	0.0	0.0	287	14718	14719
TOTAL - Launch Abort	17540	1156.2	-0.3	3.3	5071	83108	82771
LESS - MAIN AND PITCH MOTOR PROPELLANTS	-3190	1296.2	0.0	0.0	-69	-1288	-1288
TOTAL - LES Burnout	14350	1125.0	-0.3	4.1	4991	65304	64976

NOTES: \* Centers of gravity are in the NASA reference system  
except that the longitudinal axis has an origin 1000  
inches below the tangency point of the command module  
substructure mold line.

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COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LUNAR ORBIT RENDEZVOUS MISSION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT. <sup>2</sup> )					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE, LAUNCH	10030	1043.5	-0.5	5.8	4753	4195	3888	-8	-213	-46
ADJUSTMENTS (NET)	-52									
Boost & Mission Coolants										
Food & Water Consumption										
Mission Waste Pickup										
Fuel Cell Water Pickup										
Docking Provisions										
Ablator B/O, Boost										
PRIOR TO ENTRY	9978	1042.4	-0.4	6.1	4752	4117	3804	3	-227	-42
Less: Propellant	-135	1022.6	-5.1	56.6						
Ablator Burnoff	-240	1024.4	0.0	12.5						
Entry Coolant	-6	1022.6	-63.4	-16.4						
Forward Heat Shield	-336	1098.3	-0.1	3.4						
Drogue Chutes	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9211	1040.9	-0.4	5.4	4405	3576	3326	-2	-169	-37
Less: Main Chutes (3)	-382	1091.0	-0.7	7.7						
Propellant	-135	1022.6	-5.1	56.6						
LANDING	8694	1039.0	-0.3	4.5	4256	3206	2990	-3	-155	-30

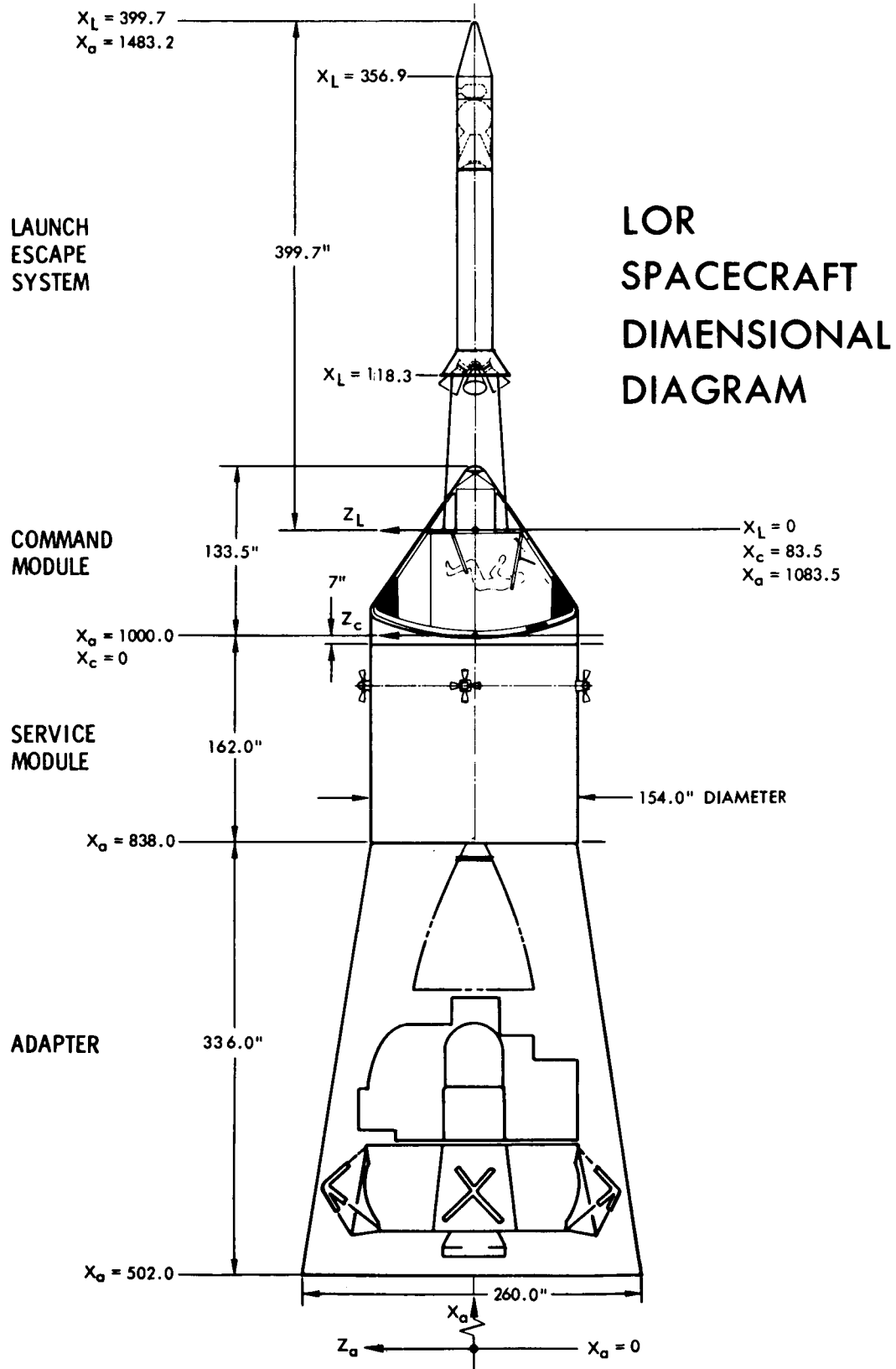
COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LOW ALTITUDE ABORT CONDITION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT. <sup>2</sup> )					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE, LAUNCH	10030	1043.5	-0.5	5.8	4753	4195	3888	-8	-213	-46
Less: Oxidant	-180	1022.6	15.6	62.4						
Forward Heat Shield	-336	1098.3	-0.1	3.4						
Docking Provisions	-100	1110.0	0.0	0.0						
Drogue Chute	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9364	1041.0	-0.8	5.1	4534	3651	3462	1	-139	-80
Less: Main Chutes (3)	-382	1091.0	-0.7	7.7						
Fuel	-90	1022.6	-46.5	44.9						
LANDING	8892	1039.0	-0.4	4.5	4417	3332	3113	-14	-137	-45



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~~CONFIDENTIAL~~SPACECRAFTWEIGHT STATUS SUMMARY(LESS LEM)

ITEM	PREVIOUS AFRM O11 STATUS 5-1-64	CHANGE TO CURRENT AFRM	CURRENT AFRM O11 WEIGHT 6-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 6-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
COMMAND MODULE	10380	-40	10340	-310	10030	41	59	
SERVICE MODULE - B/O	9950	-25	9925	+195	10120	17	73	10
LES	7500	-95	7405	+105	7510	19	74	7
ADAPTER	885		885	+2590	3475	100		
TOTAL LESS PROPELLANT	28715	-160	28555	+2580	31135	34	61	
PROPELLANT	-	-	-	-	36945		100	
GROSS WEIGHT	-	-	-	-	68080	16	82	2

INJECTED SPACECRAFTWEIGHT STATUS

ITEM	PREVIOUS LOR STATUS 5-1-64	CHANGE TO CURRENT	CURRENT LOR STATUS 6-1-64
COMMAND MODULE	10050	-20	10030
SERVICE MODULE	10120		10120
ADAPTER	3475		3475
LEM	29500		29500
TOTAL S/C Injected Less Propellant	53145	-20	53125
PROPELLANT	36970	-25	36945
TOTAL INJECTED WEIGHT	90115	-45	90070

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## COMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS AFRM OIL STATUS 5-1-64	CHANGES TO CURRENT AFRM	CURRENT AFRM OIL WEIGHT 5-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 6-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure Structure - Less Ablator Ablation Material	(4792) 3439 1353	(+27) +27	(4819) 3466 1353	(-65) +15 -80	(4754) 3481 1273	15 100	85	
Stabilization & Control	248	-14	234	-8	226	14	86	
Guidance & Navigation	378	+1	379	-26	353	45	55	
Crew Systems	447	+24	471	-16	455	19	81	8
Environmental Control	312	+6	318	-14	304	33	59	
Earth Landing System	627	+8	635		635	78	22	
Instrumentation	600	-39	561	-296	265	35	65	
Electrical Power	595	+6	601	-15	586	83	17	
Reaction Control	332		332	-2	330	62	38	
Communications	370	-30	340	+23	363	35	65	
Controls & Displays	345	-5	340	-25	315	21	78	
WEIGHT EMPTY	9046	-16	9030	-444	8586	42	58	
Scientific Equipment	-	-	-	+80	80	100		
Crew Systems	923	-24	899	+54	953	43	57	
Reaction Control	270		270		270		100	
Environmental Control	141		141		141		100	
GROSS WEIGHT	10380	-40	10340	-310	10030	41	59	

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~~CONFIDENTIAL~~COMMAND MODULECURRENT AIRFRAME WEIGHT EMPTY CHANGES

<u>STRUCTURE</u>	(+27.0)
Increase honeycomb bonding due to a change in adhesive bonding specification for the Apollo Spacecraft requiring increases in the bonding thicknesses in the splicing areas.	+20.0
Increase secondary structure wiring raceways per layout calculations.	+7.0
<u>STABILIZATION &amp; CONTROL</u>	(-14.0)
Decrease Stabilization and Control System due to deleting spares consistent with early Block I flights of short duration or unmanned.	-14.0
<u>GUIDANCE &amp; NAVIGATION</u>	(+1.0)
Increase Guidance and Navigation system due to incorporating the latest MIT report reflecting, increases in the sextant and telescope, the addition of a signal conditioner assembly and a reduction in cabling.	+1.0
<u>CREW SYSTEMS</u>	(+24.0)
Transfer water delivery tube to Crew System Useful Load.	-1.5
Decrease food storage boxes based on calculations of current drawings.	-3.4
Add storage drawer assembly required to support work and food preparation shelf.	+ .9
Increase crew couch structure and attenuation due to revising attenuation shock struts to be compatible with the new crew acceleration limits specified by NASA and incorporating lock-outs to prevent stroking of shock struts during re-entry in order to reserve the full stroking for earth impact.	+28.0

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~~CONFIDENTIAL~~COMMAND MODULECURRENT AIRFRAME WEIGHT EMPTY CHANGESENVIRONMENTAL CONTROL (+6.0)

Increase water-glycol based on revised system requirements based on calculations per AiResearch. +6.0

EARTH LANDING SYSTEM (+8.0)

Increase drogue chute system based on re-estimates of drogue riser with 15 feet cabling and the addition of cable end fittings per Northrop status. +3.6

Decrease pilot chute system based on calculated in lieu of estimated weights for risers and components per Northrop status. -.5

Increase main chute system risers based on added riser length and protective felt cover per Northrop status. +4.9

INSTRUMENTATION (-39.0)

Delete Inflight Test System consistent with early Block I flights of short duration or unmanned. -42.0

Increase Instrumentation wiring based on current calculations of wiring diagrams. +3.0

ELECTRICAL POWER (+6.0)

Increase common utility due to the addition of a fuse box assembly based on sequencing requirements which due to size limitations could not be incorporated in the mission sequencer. +6.0

COMMUNICATIONS (-30.0)

Decrease Communications system due to deleting spares consistent with early Block I flights of short duration or unmanned. -25.0

Decrease wiring based on eliminating provisions for the high gain antenna controls not required on Airframe 011. -6.0

Increase signal conditioner based on partial weights reflected in current Collins status. +1.0

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~~CONFIDENTIAL~~COMMAND MODULECURRENT AIRFRAME WEIGHT EMPTY CHANGESCONTROLS AND DISPLAYS

(-5.0)

Delete high gain antenna control based on Airframe Oll requirements.

-2.5

Decrease reaction control system quantity gauging panel due to reflecting the current vendor status in lieu of estimated weights.

-2.7

Increase crew area manual controls based on current honeycomb status reflecting increased cabling lengths.

+.2

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TOTAL COMMAND MODULE CURRENT AIRFRAME WEIGHT EMPTY CHANGES

-16.0

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~~CONFIDENTIAL~~COMMAND MODULECURRENT AIRFRAME USEFUL LOAD CHANGESCREW SYSTEMS

(-24.0)

Increase spacesuit pressure garment assembly per Hamilton Standard engineering memo reflecting current component weights.	+48.8
Add spacesuit mounted communication, electrical monitoring and telemetry per Hamilton Standard engineering memo reflecting current component weights.	+2.4
Decrease constant wear garments based on Hamilton Standard engineering memo reflecting current component weights.	-3.1
Transfer water probe from Crew Systems weight empty.	+1.5
Decrease medical equipment based on current estimate of medical requirements.	-2.6
Increase survival kit contents based on current estimate of crew survival requirements.	+11.9
Decrease survival kit containers based on calculations of released drawings reflecting a reduced gauge.	-.8
Decrease personal hygiene equipment based on current estimate of hygiene requirements.	-4.9
Delete portable life support systems as the current Block I requirement includes no provisions for extra vehicular activity.	-84.0
Add crew optics (side mirrors) required for forward viewing of chute deployment and LES jettison per NASA Ltr 1891 MA, 5 February 1964.	+6.0
Add supports required to install various equipment.	+8

TOTAL COMMAND MODULE CURRENT AIRFRAME USEFUL LOAD CHANGES

-24.0

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SERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS AFRM OLL STATUS 5-1-64	CHANGES TO CURRENT AFRM	CURRENT AFRM OLL WEIGHT 6-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 6-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	2305		2305	+75	2380	9	76	15
Environmental Control	170	-2	168	-80	88	12	87	1
Instrumentation	130		130	+3	133	26	74	
Electrical Power	1436		1436	+13	1449	15	34	51
Propulsion System Engine Installation	(3079) 727		(3079) 727		(3079) 727	50	50	
Propulsion System	2352		2352		2352	13	87	
Reaction Control	576		576		576	61	39	
Communications & Rendezvous Radar	24	-23	1	+184	185	100		
WEIGHT EMPTY	7720	-25	7695	+195	7890	21	65	14
RCS Propellant	838		838		838		100	
Electrical Power Super. Fluids	503		503		503		100	
Environmental Contr. Super. Fluids	208		208		208		100	
Main Propulsion Helium	99		99		99		100	
Main Propulsion Residuals	(582) 225		(582) 225		(582) 225		100	
Trapped - System	67		67		67			
Trapped - Engine	100		100		100			
Mixture Ratio Tolerance	190		190		190			
Loading Tolerance								
BURNOUT WEIGHT	9950	-25	9925	+195	10120	17	73	10
Main Propellant					36945		100	
GROSS WEIGHT					47065	4	94	2



~~CONFIDENTIAL~~SERVICE MODULECURRENT AIRFRAME WEIGHT EMPTY CHANGES

<u>ENVIRONMENTAL CONTROL</u>	(-2.0)
Decrease space radiators based on calculation of drawings reflecting increased chem-milling in the flow passage areas.	-2.0
<u>COMMUNICATION &amp; RENDEZVOUS RADAR</u>	(-23.0)
Decrease electrical provisions due to deleting the wiring and coax required for the high gain antenna.	-23.0
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TOTAL SERVICE MODULE CURRENT AIRFRAME WEIGHT EMPTY CHANGES	-25.0

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~~CONFIDENTIAL~~LAUNCH ESCAPE SYSTEMWEIGHT STATUS

ITEM	PREVIOUS AFRM 011 STATUS 5-1-64	CHANGE TO CURRENT AFRM	CURRENT AFRM 011 WEIGHT 6-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 6-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	1314	-75	1239		1239	45	55	
Electrical System	85		85		85	5	95	
Propulsion System								
Main Thrust	4774		4774		4774		100	
Jettison	434		434		434			100
Jettison Motor								
Skirt	92		92		92			100
Pitch Control	49		49		49		100	
Separation Provisions	13		13		13		100	
C/M Boost Prot. Cover				+185	185	100		
LES - NO BALLAST	6761	-75	6686	+185	6871	11	81	8
BALLAST	739	-20	719	-80	639	100		
TOTAL L.E.S.	7500	-95	7405	+105	7510	19	74	7

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~~CONFIDENTIAL~~LAUNCH ESCAPE SYSTEMCURRENT AIRFRAME CHANGESSTRUCTURE

(-75)

Decrease tower insulation based on redefined boost and re-entry heating rates and raising the titanium allowable temperature to 800°F.

-75

BALLAST

(-20)

Decrease ballast consistent with current Command Module and LES balance requirements.

-20

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TOTAL LAUNCH ESCAPE SYSTEM CURRENT AIRFRAME WEIGHT CHANGES

-95

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~~CONFIDENTIAL~~ADAPTERWEIGHT STATUS

ITEM	PREVIOUS AFRM O11 STATUS 5-1-64	CHANGE TO CURRENT	CURRENT AFRM O11 WEIGHT 6-1-64	ESTIMATED CHANGE TO LOR	CURRENT LOR WEIGHT 6-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	709		709	+2336	3045			
Electrical	20		20	+50	70			
Separation System	156		156	+204	360			
TOTAL ADAPTER	885		885	+2590	3475	100		

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~~CONFIDENTIAL~~COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

STRUCTURE	(-65.0)
Eliminate the heat shield substructure face sheet pads (scar weight) provided on the first few spacecrafts for designs that were not consumated (strakes, plugs, vents, etc.).	-26.0
Analyze structure design in detail based on a refinement of loading conditions, as the original design was accomplished on an extremely tight schedule utilizing a minimum of loads and equipment information.	-40.0
Incorporate a boost protection cover over the Command Module nose to be jettisoned with the Launch Escape System tower. This would allow the ablative material thickness on the nose to be reduced.	-30.0
Reduce the spacecraft temperature criteria from 250°F to 200°F. A saving of approximately one pound of ablative material can be removed for every degree reduction at start of entry.	
Refine secondary structure design by additional machining of extrusions utilized in coldplate closeouts, alternate materials, and a reduction of supports for scientific equipment.	-60.0
Reduce heat shield window glass thickness from 0.70 inch to 0.55 inch based on a more detailed thermal and structural analysis.	-10.0
Add LEM docking provisions for the LOR mission.	+150.0
Add lower equipment bay supports required for food compartments which were accomplished on Airframe 011 by a food storage box designed by Crew Systems.	+8.0
Decrease secondary structure heat shield equipment area due to removing supports which are installed in the early Airframe for support of flight qualification equipment.	-4.0
Decrease the heat shield substructure due to inlarging the umbilical from 1100 to 1300 wires which requires a larger cutout in the heat shield.	-3.0

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~~CONFIDENTIAL~~COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

<u>STABILIZATION AND CONTROL</u>	(-8.0)
Remove all elapsed time indicators prior to flight.	-1.0
Utilized partial potting in low dissipation ECA modules.	-5.0
Reduce total length of ECA package. Packages are presently designed to include growth capabilities.	-3.0
Delete multiple monitor relays in DC amplifiers.	-1.0
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-12.5
Increase the Stabilization and Control System due to current LOR requirement for spares.	+14.5
<u>GUIDANCE AND NAVIGATION</u>	(-26.0)
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-8.0
Decrease guidance and navigation system due to incorporating the Block II G & N system for the lunar spacecraft.	-18.0
<u>CREW SYSTEMS</u>	(-16.0)
Decrease food storage boxes as the design for the LOR vehicle will be accomplished by the secondary structure supports in lieu of using a removable stowage as is used on Airframe 011.	-16.0
<u>ENVIRONMENTAL CONTROL</u>	(-14.0)
Utilize a combined tank with separate compartments for waste water and potable water.	-4.0
Delete provisions for Service Module temperature control system as the requirements for the LOR vehicle have not been thoroughly defined at this time.	-10.0

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~~CONFIDENTIAL~~COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LORINSTRUMENTATION

(-296.0)

Delete instrumentation required for flight qualification.	-305.0
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible, reducing wire gage based on electrical load analysis and reducing instrumentation wiring by utilizing unshielded wire where possible.	-33.7
Add Nuclear Radiation Detection provisions required for the lunar vehicle.	+.7
Increase Instrumentation due to adding an inflight test system based on current LOR requirements.	+ 42.0

ELECTRICAL POWER

(-15.0)

Increase electrical common utility due to increasing the capacity of the C/M to S/M umbilical from 1100 wires to 1300 wires required for lunar vehicle.	+16.0
Delete the sequencer system required to perform separation of the spacecraft from the booster during normal spacecraft-booster separation or a service propulsion system abort situation as this system is required for earth orbit missions only.	-12.0
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-19.0

REACTION CONTROL

(-2.0)

Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-2.0
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~~CONFIDENTIAL~~COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LORCOMMUNICATIONS

(+23.0)

Decrease electrical wiring due to utilizing thin wall teflon installation where possible and reducing wire gage based on electrical load analysis.

-8.0

Increase Communications due to adding spares based on current LOR requirements.

+25.0

Increase electrical provisions due to adding wiring required for the high gain antenna.

+6.0

CONTROLS AND DISPLAYS

(-25.0)

Reduce weight of displays by utilizing lamps in lieu of the barometric pressure indicator and by sharing cryogenic pressure and quantity readouts between the hydrogen and oxygen requirements.

-4.0

Delete the self-test capability of the SCS displays.

-2.0

Chem-etch mounting panels for the LOR vehicles that could not be accomplished due to schedule on Airframe Oll.

-3.5

Delete present reaction jet solenoid power switching relays from the SCS mode select panel. Utilize a manual switch and circuit breakers for reaction jet solenoid power control.

-2.0

Decrease lower equipment bay G & N controls and displays due to incorporating the Block II G & N system for the lunar spacecraft.

-1.6

Replace roll attitude error needle servo drive with galvanometer movement.

-1.0

Add rendezvous radar panel required for LOR mission.

+13.0

Delete console interface connectors resulting in some complications in manufacturing and repair of console.

-9.0

Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.

-15.8

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~~CONFIDENTIAL~~COMMAND MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LORCONTROLS AND DISPLAYS (Cont'd)

Add Nuclear Radiation Display required for the lunar vehicle that was previously assumed to be on Airframe 011.	+1.4
Delete Service Module temperature control panel as the requirements for the LOR vehicle have not been thoroughly defined at this time.	-3.0
Add high gain antenna control required for deep space communication.	+2.5

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TOTAL COMMAND MODULE CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR	-44.0
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~~CONFIDENTIAL~~COMMAND MODULECURRENT ESTIMATED USEFUL LOAD CHANGES TO LOR

<u>SCIENTIFIC EQUIPMENT</u>	(+80.0)
Add scientific equipment based on current LOR mission requirements.	+80.0
<u>CREW SYSTEM</u>	(+54.0)
Add one portable life support system based on the current requirements of the LOR vehicle and LEM.	+60.0
Decrease hygiene and medical storage boxes based on redesign of containers that cannot be accomplished on Airframe 011.	-6.0
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TOTAL COMMAND MODULE CURRENT ESTIMATED USEFUL LOAD CHANGES TO LOR	+134.0

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~~CONFIDENTIAL~~SERVICE MODULECURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

<u>STRUCTURE</u>	(+75.0)
Add structural beef-up required to support the rendezvous radar equipment.	+35.0
Add structural provisions for supporting the high gain antenna, previously assumed to be on Airframe 011.	+30.0
Increase structural provision for the C/M to S/M umbilical fairing due to enlarging the capacity from 1100 to 1300 wires.	+10.0
<u>ENVIRONMENTAL CONTROL</u>	(-80.0)
Delete Service Module temperature control system as the requirements for the LOR vehicle have not been thoroughly defined at this time	-80.0
<u>INSTRUMENTATION</u>	(+3.0)
Add radiation detection sensors to the Service Module due to changing to a system which senses proton bombardment only.	+3.0
<u>ELECTRICAL POWER</u>	(+13.0)
Increase C/M to S/M umbilical due to enlarging from capacity from 1100 wires to 1300 wires.	+13.0
<u>COMMUNICATIONS &amp; RENDEZVOUS RADAR</u>	(+184.0)
Add high gain antenna system required for deep space communications	+64.0
Add rendezvous radar equipment consistent with the LOR requirements.	+120.0
 TOTAL SERVICE MODULE ESTIMATED WEIGHT EMPTY CHANGES TO LOR	 +195.0

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~~CONFIDENTIAL~~LAUNCH ESCAPE SYSTEMCURRENT ESTIMATED WEIGHT CHANGES TO LORSTRUCTURE

(+185)

Add a boost heat shield for protection of the forward compartment during boost heating. The addition of the boost heat shield reduces the forward compartment heat shield ablative thickness and lightens the injected spacecraft weight.

+185

BALLAST

(-80)

Decrease ballast consistent with current Command Module LES balance requirements.

-80

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TOTAL LAUNCH ESCAPE SYSTEM CURRENT ESTIMATED WEIGHT CHANGES TO LOR

+105

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ADAPTER

CURRENT ESTIMATED WEIGHT CHANGES TO LOR

Utilize the S-IV B Adapter consistent with the current LOR  
mission requirements in lieu of the S-IV Airframe Oll  
Adapter

+2590

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~~CONFIDENTIAL~~WEIGHT HISTORY COMMENTS

## LAUNCH ESCAPE SYSTEM

The design goal established for the LES is 6,300 pounds, excluding ballast. This weight was based on the September 1962 status weight of 6,600 pounds, including the necessary ballast to provide currently determined aerodynamic stability to prevent tumbling.

The original design goal of 5,900 pounds, as reported in the June status, SID 62-99-5, was based on an attitude controlled configuration. The current configuration weight includes a pitch motor and ballast not included in the original target weight.

## COMMAND MODULE

The design goal established for the Command Module is 8,500 pounds. An estimated weight breakdown for the design goal is provided for comparative purposes.

The original design goal weight of 8,340 pounds, as reported in the June status, SID 62-99-5, did not include the proposed increases nor the Category I reductions presented in the July briefing and incorporated in the July Status Report.

## SERVICE MODULE

The design goal established for the Service Module less usable propellant is 11,000 pounds. An estimated weight breakdown for the design goal is provided for comparative purposes. This configuration is sized for 45,000 pounds usable propellant for the 25,000 pound LEM.

The original design goal weight of 8,595 for the burnout condition was based on lunar configuration sized for 31,000 pounds usable propellant.

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~~CONFIDENTIAL~~WEIGHT HISTORYCOMMAND MODULE

ITEM	DESIGN GOAL	AUTHORIZED CHANGES	DESIGN GOAL ADJUSTED 6-1-64
Structure	3824	+277	4101
Stabilization & Control	181		181
Guidance & Navigation	261	+82	343
Crew System	530		530
Environmental Control	235	-11	224
Earth Landing System	610	+49	659
Instrumentation	173	+7	180
Electrical Power	390	+10	400
Reaction Control	195		195
Communication	330	+33	363
Controls & Displays	261	+19	280
WEIGHT EMPTY	6990	+466	7456
Scientific Equipment	250	-170	80
Crew	528		528
Suits & Personal Equipment	304	+58	362
Food & Containers	90		90
Reaction Control Propellant	210		210
Environmental Control Fluids	128		128
GROSS WEIGHT	8500	+354	8854

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~~CONFIDENTIAL~~COMMAND MODULE WEIGHT HISTORYWEIGHT EMPTY AUTHORIZED CHANGES

STRUCTURE	(+277)
Change parachute attach to a two leg configuration for incorporation of the "Tumbling Concept" at earth impact attenuation. (CCA No. 93)	+125
Delete the extendable heat shield window covers and replace current windows with high temperature glass consisting of (3) parallel glass panes. (CCA No. 105)	+2
Add LEM docking provisions for LOR.	+150
GUIDANCE & NAVIGATION	(+82)
Increase the Guidance and Navigation per recent weight report from MIT. Since NAA does not have weight control responsibility for the MIT design, the weight changes in their Weight and Balance Report will be considered as authorized changes.	+ 82
ENVIRONMENTAL CONTROL	(-11)
Add a CO <sub>2</sub> sensor to the ECS as a part of the ECS operational instrumentation. (CCA No. 43)	+2
Add a surge tank to ECS and delete entry oxygen supply to provide early mission emergency gas flows. (CCA No. 52)	-7
Deletion of regenerative heat exchanger from the ECS heat exchanger package. (CCA No. 63)	-7
Decrease pressure suit gas flow requirement for ventilation flow from 12 CFM to 10 CFM. (CCA No. 121)	+1
EARTH LANDING SYSTEM	(+49)
Add a dual drogue system installation to replace the single drogue system. (CCA No. 195)	+49

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~~CONFIDENTIAL~~COMMAND MODULE WEIGHT HISTORYWEIGHT EMPTY AUTHORIZED CHANGES

## INSTRUMENTATION (+7)

Increase the PCM output bit rate from 31,000 to 51,200 bit/sec.

This change was originally considered to have negligible weight affect but has henceforth been reported by Collins to cause a seven pound increase. (CCA No. 44)

+7

## ELECTRICAL POWER (+10)

Add two batteries to provide a source of power, separate from the primary D.C. power, to initiate pyrotechnic devices. (CCA No. 28)

+10

Delete automatic LES Tower ejection function from flight sequencer for normal missions. (CCA No. 91)

-1

Provide a PLSS battery charger connection to the Spacecraft battery charger that will allow charging of the 28 volt battery through the battery charging selector switch. (CCA No. 82)

+1

## COMMUNICATIONS (+33)

Add a spacecraft up-data link for the purpose of providing current GOSS data within the spacecraft for display and comparison with the on-board computed data. (CCA No. 54)

+35

Change the present two speed data storage to a three speed machine to provide fast dump of data. (CCA No. 59)

-2

## CONTROLS &amp; DISPLAYS (+19)

Furnish and install a clock timer panel at the navigation station lower equipment bay. (CCA No. 84)

+2

Increase G & N navigation controls coded to controls and displays per MIT status.

+4

Add rendezvous radar for LOR.

+ 13

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TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES +466

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~~CONFIDENTIAL~~COMMAND MODULE WEIGHT HISTORYUSEFUL LOAD AUTHORIZED CHANGES

## SUITS &amp; PERSONAL EQUIPMENT

(+58)

Change the following GFE (NASA) responsibility items:

Increase personal radiation dosimeters per NASA Crew Systems Meeting Number 19, Action Item Number 6.	+10
Increase PLSS per Hamilton Standard status.	+72
Delete initial charge water for coolant, from PLSS, as this item is now carried in the potable water tank.	-5
Delete one PLSS consistent with requirements for LOR mission.	-66
Delete primary oxygen from remaining PLSS.	-1
Increase Pressure Garment Assembly per Hamilton Standard engineering memo.	+49
Add a spacesuit mounted communication, electrical monitoring and telemetry per Hamilton Standard.	+2
Decrease constant wear garments per Hamilton Standard.	-3

## SCIENTIFIC EQUIPMENT

(-170)

Delete the requirement to carry 170 pounds of scientific equipment in the lower equipment bay per NASA direction. (CCA No. 186)	-170
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## TOTAL COMMAND MODULE USEFUL LOAD CHANGES

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~~CONFIDENTIAL~~WEIGHT HISTORYSERVICE MODULE

ITEM	DESIGN GOAL	AUTHORIZED CHANGES	DESIGN GOAL ADJUSTED 6-1-64
Structure	3203	+40	3243
Environmental Control	250		250
Instrumentation	100		100
Electrical Power	1203		1203
Propulsion System			
Engine Installation	606		606
Propellant System	2456		2456
Reaction Control	737		737
Communications & Rendezvous Radar	45	+120	165
WEIGHT EMPTY	8600	+160	8760
Usable RCS Propellant	611		611
Usable Fuel Cell Reactants	479		479
Environmental Control Fluids	193		193
Main Propulsion Helium	139		139
Main Prop. Residuals	900		900
Unusable RCS Propellant	61		61
Unusable Fuel Cell Reactants	17		17
BURNOUT WEIGHT	11000	+160	11160
Main Propellant	45000		45000
GROSS WEIGHT	56000	+160	56160

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~~CONFIDENTIAL~~SERVICE MODULE WEIGHT HISTORYWEIGHT EMPTY AUTHORIZED CHANGES

STRUCTURE	(+40)
Add structural beef-up required to support the rendezvous radar equipment.	+40
COMMUNICATION & RENDEZVOUS RADAR	(+120)
Add rendezvous radar equipment consistent with the LOR requirements.	+120
	<hr/>
TOTAL SERVICE MODULE WEIGHT EMPTY CHANGES	+160

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGESCOMMAND MODULE

ITEM	AIRFRAME O11	LOR SPACECRAFT
<u>CURRENT DESIGN CHANGES</u>		
<u>STRUCTURE</u>	(+124)	(+124)
Increase ablator consistent with current AVCO status. NAA is currently studying AVCO's ablator thicknesses and densities versus new heating rates.	+124	+124
<u>CREW SYSTEMS</u>	(-9)	(-9)
Reduce trilox pads from three layers to two layers and delete worktable assembly per current requirements.	-3	-3
Decrease flight kits based on redesign deleting sextants.	-6	-6
<u>EARTH LANDING SYSTEM</u>	(+23)	(+23)
Increase Main Parachutes based on latest vendor information.	+23	+23
<u>COMMUNICATIONS</u>	(+7)	(+7)
Increase signal conditioner due to replacing dummy modules with active signal conditioning module for redundancy.	+7	+7
SUBTOTAL CURRENT DESIGN CHANGES	+145	+145

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>MANDATORY CHANGES TO LOR</u>		
<u>STRUCTURE</u>		(+27)
Relocate forward pitch engines.		+7
Increase secondary structure due to adding electrical coldplates and redundant passages.		+10
Add provisions to allow extra vehicular activity thru the side hatch.		+10
<u>STABILIZATION &amp; CONTROL</u>		(+35)
Increase wiring based on adding S-IV B control interface and body bending filters.		+5
Increase equipment due to miscellaneous humidity and EMI proofing.		+30
<u>CREW SYSTEMS</u>		(+76)
Addition of crew optics to provide a necessary visual alignment aid during docking.		+6
Increase egress accessories due to adding aids for extra vehicular activities.		+10
Add one PLSS based on current requirements for two in the Command Module.		+60
<u>ENVIRONMENTAL CONTROL</u>		(+25)
Provide the CO <sub>2</sub> absorber elements with a bypass in order to attain minimum oxygen flow of 10 CFM/Man in 3.5 psia (suited) condition.		+10
Add free condensate control to minimize free water build up that could degrade electronic equipment.		+10
Add LEM water transfer system.		+5

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>EARTH LANDING SYSTEM</u>		(+61)
Add a flotation bag system to provide an attitude equivalent to that of the Block I configuration.		+15
Main parachute redesign for higher descending weight.		+46
<u>INSTRUMENTATION</u>		(+56)
Add provisions to provide for S-IV B EDS interface.		+25
Add checkout provisions for the LEM in the stowed and docked position.		+31
<u>ELECTRICAL POWER</u>		(+155)
Incorporate complete EPS humidity fix.		+10
Add a DC to DC regulator.		+4
Increase wiring for 1300 wires 1600 pin umbilical.		+141
<u>COMMUNICATIONS</u>		(+39)
Increase equipment due to miscellaneous humidity and EMI proofing.		+20
Add a redundant S-Band power amplifier.		+6
Replace the scimitar antenna with the "S" band antenna.		+22
Transfer the VHF antenna to the Service Module.		-15
Add provisions for switchable redundant S-Band Transponder and Premodulation Processor.		+5
Increase VHF-HF Recovery provisions due to adding VHF decent and post landing HF Antennas.		+1

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>CONTROLS AND DISPLAYS</u>		(+42)
Increase rendezvous radar control panel wiring.		+11
Modify control and displays for the lunar vehicle.		+29
Add GOSS updating to CTE.		+2
SUBTOTAL MANDATORY CHANGES TO LOR		+516

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>WEIGHT REDUCTIONS TO LOR</u>		
<u>STRUCTURE</u>		(-424)
Decrease ablator due to adding a full boost protective cover eliminating boost ablator and adding thermal paint reducing entry temperatures. (+30 -265)*		-235
Decrease ablator due to changing ablator thickness to criteria of 600°F at chute deployment. (+50 -50)*		0
Remove window from side hatch and replace with panel for Lunar Landing Mission.		-25
Decrease structure due to incorporating the following:		
Incorporation of a flat top heat shield. (+66 -73)*		-7
Replacement of copper vent with beryllium.		-8
Utilization of titanium pork chop frames and stringers.		-41
Incorporation of single point parachute attachment.		-80
Reduction of factor of safety criteria from 1.5 to 1.4 in all areas requiring redesign.		-6
Replace rendezvous window well castings with honeycomb.		-11
Relocation of aft compartment equipment for center of gravity improvement.		-7
Removal of forward heat shield access door.		-5
Decrease lower equipment bay structure and coldplates based on the ring mounting concept design. (+60 -79)*		-19
Revise lower equipment bay due to deleting in-flight maintenance.		+20

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>STABILIZATION &amp; CONTROL</u>		(-56)
Decrease equipment and wiring due to repackaging for the ring mounted lower equipment bay concept and incorporating switchable redundant parts. (+10 -40)*		-30
Delete requirement for in-flight maintenance.		-26
<u>CREW SYSTEMS</u>		(-62)
Incorporate optimized crew couch design.		-40
Reduce food due to offloading for a 10 day in lieu of 14 day mission. (Useful Load)		-22
<u>ENVIRONMENTAL CONTROL</u>		(-28)
Reduce lithium hydroxide due to off loading for a 10 day in lieu of 14 day mission. (Useful Load)		-28
<u>EARTH LANDING SYSTEM</u>		(-24)
Incorporate Block II configuration utilizing a single point parachute attachment and repackaging of chutes.		-14
Reduce thrusters due to changing from four tension springs to two.		-10
<u>INSTRUMENTATION</u>		(-32)
Delete in-flight test system and depend on the caution and warning to give information for switching.		-32
<u>ELECTRICAL POWER</u>		(-200)
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors. (+105 -270)*		-165
Repackage post-landing batteries.		-20
Utilize fuel cell power in lieu of pyro battery for S/M separation.		-15

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POTENTIAL WEIGHT CHANGES (CONTINUED)COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>COMMUNICATION</u>		(-148)
Eliminate C-Band and utilize S-Band for low altitude tracking.		-30
Decrease equipment and wiring due to repackaging for the ring mounted lower equipment bay concept.		-85
Decrease equipment due to deleting requirement for in-flight maintenance.		-33
<u>CONTROLS AND DISPLAYS</u>		(-17)
Delete main display computer keyboard and utilize LEB computer control only.		-31
Decrease main display panel due to eliminating subpanels and display by increasing time sharing of displays. (+24 -10)*		+14
SUBTOTAL WEIGHT REDUCTIONS TO LOR		-991
Due to lack of realistic design data a contingency weight allowance is included in accordance with the May Block II briefing to NASA.		+160
Add ballast required to insure an L/D of .43.	+310	+220
TOTAL POTENTIAL WEIGHT CHANGES - COMMAND MODULE	+455	+50

\*Weight changes included in estimated changes to LOR.

~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGESSERVICE MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>CURRENT DESIGN CHANGES</u>		
<u>STRUCTURE</u>	(+50)	(+50)
Increase engine mount and backup structure due to stiffness requirements.	+50	+50
<u>REACTION CONTROL SYSTEM</u>	(+12)	(+12)
Redesign RCS engine support housing to accommodate increased dynamic loads.	+12	+12
<u>PROPULSION</u>	(+210)	(+210)
Increase SPS propellant based on new mixture ratio tolerance and trapped residuals.	+210	+210
SUBTOTAL CURRENT DESIGN CHANGES	+272	+272

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)SERVICE MODULE

ITEM	AIRFRAME O11	LOR SPACECRAFT
<u>MANDATORY CHANGES TO LOR</u>		
<u>STRUCTURE</u>		(+200)
Add meteoroid protection.		+100
Incorporate passive SPS and RCS thermal control. (Insulation, propellant, etc.)		+100
<u>ENVIRONMENTAL CONTROL</u>		(+100)
Incorporate an ECS radiator freon system.		+100
<u>INSTRUMENTATION</u>		(+22)
Add provisions for IEM monitoring including wiring.		+22
<u>ELECTRICAL POWER</u>		(+75)
Increase wiring for 1300 wires 1600 pin umbilical.		+75
<u>COMMUNICATIONS</u>		(+31)
Transfer VHF communication antenna from the Command Module.		+31
SUBTOTAL MANDATORY CHANGES TO LOR		+428

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGES (CONTINUED)SERVICE MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
<u>WEIGHT REDUCTIONS TO LOR</u>		
<u>STRUCTURE</u>		(-380)
Decrease structure due to reducing factor of safety from 1.5 to 1.4 on all structures requiring redesign.		-25
Shorten Service Module structure from 155 inches to 145 inches to be compatible with the shorter propellant tanks and refine Service Module design for weight savings.		-355
<u>ELECTRICAL POWER</u>		(-130)
Decrease wiring and connectors based on reduced wire gauges and utilizing small connectors.		-130
<u>PROPULSION</u>		(-350)
Decrease propellant and oxidizer tank gauges based on refined tank pressure regulation by utilizing precision valves which allow design for pressure relief at 225 psi rather than 240 psi.		-50
Decrease propellant and oxidizer tanks due to shortening the tank for a 41,000 pound usable propellant.		-200
Decrease propellant and oxidizer tank gauges based on reducing helium quantity and allowing for Pc decay.		-90
Incorporate SPS electrically operated ball valves.		-10
SUBTOTAL WEIGHT REDUCTIONS TO LOR		-860
Due to lack of realistic design data, a contingency weight allowance is included in accordance with the May Block II briefing.		+170
TOTAL POTENTIAL WEIGHT CHANGES - SERVICE MODULE	+272	+10

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGESLAUNCH ESCAPE SYSTEM

ITEM	AIRFRAME O11	LOR SPACECRAFT
Add a full boost protective cover that will be jettisoned simultaneously with the LES.	+520	+335
Increase ballast consistent with full boost protective cover.	+75	
TOTAL POTENTIAL WEIGHT CHANGES - LAUNCH ESCAPE SYSTEM	+595	+335

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~~CONFIDENTIAL~~POTENTIAL WEIGHT CHANGESADAPTER

ITEM	AIRFRAME 011	LOR SPACECRAFT
Add Service Module and LEM dispersal system.	+100	+100
TOTAL POTENTIAL WEIGHT CHANGES - ADAPTER	+100	+100

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULESUMMARY

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>WEIGHT EMPTY</u>	(9030)	(-444)	(8586)
Structure	4819	-65	4754
Stabilization & Control	234	-8	226
Guidance & Navigation	379	-26	353
Crew Systems	471	-16	455
Environmental Control System	318	-14	304
Earth Landing System	635		635
Instrumentation	561	-296	265
Electrical Power System	601	-15	586
Reaction Control System	332	-2	330
Communications	340	+23	363
Controls & Displays	340	-25	315
<u>USEFUL LOAD</u>	(1310)	(+134)	(1444)
Scientific Equipment		+80	80
Crew Systems	899	+54	953
Reaction Control System	270		270
Environmental Control System	141		141
GROSS WEIGHT	10340	-310	10030

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULESTRUCTURE

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>STRUCTURE</u>			
Inner Structure			
Forward Section	(206)		(206)
Honeycomb	66		66
Frames, Rings, Hatches & Mech.	57		57
Fittings & Attachments	83		83
Center Section	(695)	(-11)	(684)
Honeycomb Panels	227	-11	216
Longerons, Frames and Rings	263		263
Window and Hatches	104		104
Fittings and Attachments	101		101
Aft Section	(201)	(-6)	(195)
Honeycomb Panel	122	-6	116
Ring	79		79
Subtotal Inner Structure	1102	-17	1085
Secondary Structure			
RH Equipment Bay and Coldplates	99	-9	90
LH Equipment Bay	93	-9	84
Fwd. RH Equipment Bay and Coldplates	19		19
Main Display Panel and Coldplates	71	-7	64
Lower Equipment Bay and Coldplates	218	-15	203
Aft Equipment Bay	73	-8	65
Crew Area	5		5
Fwd LH Equipment Bay	20		20
Heat Shield Equipment Area	52	-8	44
Subtotal Secondary Structure	650	-56	594
Ablation Material			
Forward Section	151	-35	116
Center Section	550	-21	529
Aft Section	652	-24	628
Subtotal Ablation Material	1353	-80	1273
TOTAL TO BE BROUGHT FORWARD	3105	-153	2952

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULESTRUCTURE

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>STRUCTURE (Continued)</u>			
Heat Shield Substructure			
Forward Section	(197)	(-4)	(193)
Honeycomb Panels & Closeouts	107	-4	103
Frames, Rings and Access Doors	35		35
Fittings, Attach. & Mechanisms	55		55
Center Section	(756)	(-47)	(709)
Honeycomb Panels & Closeouts	273	-28	245
Frames & Rings	116		116
Access Doors, Windows & Hatch Covers	211	-19	192
Fittings, Mechanism & Attach H.S.	132		132
Air Vent	24		24
Aft Section	(544)	(-11)	(533)
Honeycomb Panels & Closeouts	371	-11	360
Frames & Rings	47		47
Fittings & Attach. R.S.	73		73
Toroidal Assembly	53		53
Subtotal Heat Shield Substructure	1497	-62	1435
Insulation	195		195
Separation Provisions & Attachments	22		22
LEM Docking Provisions		+150	150
TOTAL This Page	1714	+88	1802
TOTAL To be brought forward from Page 48	3105	-153	2952
TOTAL STRUCTURE	4819	-65	4754

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULESTABILIZATION AND CONTROL

	AIRFRAME Oll 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>STABILIZATION AND CONTROL</u>			
Lower Equipment Bay	(181.6)	(+4.5)	(186.1)
Rate Gyro Package	7.6	-.1	7.5
Body Mounted Gyro Package	12.9	-.1	12.8
Electronic Control Package - Pitch	30.2	-1.9	28.3
Electronic Control Package - Roll	30.5	-1.9	28.6
Electronic Control Package - Yaw	30.9	-2.0	28.9
Electronic Control Package - Auxiliary	30.8	-2.0	28.8
Display/BMAG ECA Package	38.7	-2.0	36.7
Spare Gyro - BMAG (2)		+2.0	2.0
Spare Gyro - Rate		+ .5	.5
Spare Plug-In Module		+12.0	12.0
Electrical Provisions	(52.4)	(-12.5)	(39.9)
Wiring, etc.	51.8	-12.5	39.3
SCS Power Junction Box	.6		.6
TOTAL STABILIZATION AND CONTROL	234.0	-8.0	226.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEGUIDANCE & NAVIGATION

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>GUIDANCE AND NAVIGATION</u>			
Electronic Equipment	(247.6)	(-17.4)	(230.2)
Inertial Measurement Unit	60.2	-18.2	42.0
Navigation Base	25.0	-3.0	22.0
Computer & Spare Tray	70.0	+22.6	92.6
Power Servo Assembly	59.8	-14.7	45.1
Coupling Display Unit	14.5	+ .5	15.0
Bellows Assembly	13.5		13.5
Signal Conditioner Assy	4.6	-4.6	-
Optical Equipment	(49.7)	(+3.6)	(53.3)
Sextant	15.1	+3.6	18.7
Telescope	14.3		14.3
Optical Base	16.7		16.7
Optical Eyepieces	3.6		3.6
Coolant Hoses	(1.0)		(1.0)
Electrical Provisions	(73.2)	(-8.0)	(65.2)
Cabling MIT	38.0		38.0
Cabling NAA	35.2	-8.0	27.2
Loose Stored Items	(7.5)	(-4.2)	( 3.3)
Film Cartridges (4)	2.4	-.6	1.8
Eye Relief Eyepiece	1.5		1.5
Horizon Photometer	3.6	-3.6	-
TOTAL GUIDANCE AND NAVIGATION	379.0	-26.0	353.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULECREW SYSTEMS

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>CREW SYSTEMS</u>			
Crew Accessories	(3.0)		(3.0)
Egress Accessories - Hatch	3.0		3.0
Crew Couch Structure & Attenuation	(380.7)		(380.7)
Center Couch (1)	80.0		80.0
Outboard Couches (2)	203.7		203.7
Attenuation	97.0		97.0
Crew Couch Pads & Restraints	(30.8)		(30.8)
Pad Assy - Couch	10.8		10.8
Harness Assy. - Restraint	12.0		12.0
Restraint Assy - Rest Station	4.0		4.0
Restraint Lower Equip. Bay	2.0		2.0
Sandals - Weightless Restraint	2.0		2.0
Window Filter Assemblies	(3.8)		(3.8)
Food Associated Equipment	(25.4)	(-16.0)	(9.4)
Shelf Assy - Work/Food Preparation	1.9		1.9
Storage Drawer Assy - Work/Food Shelf	.9		.9
Food Storage Boxes	21.6	-16.0	5.6
Water Metering	1.0		1.0
Waste Mangement System (See ECS for System Wt.)	(2.7)		(2.7)
Canister Assy - Fecal	1.4		1.4
Receptacle Assy - Relief Crewman	1.3		1.3
Crew Equipment	(24.2)		(24.2)
Umbilical Assy - Crewman	17.9		17.9
Hose Assy.-PLSS O <sub>2</sub> Recharge	2.8		2.8
Electrical Umbilical - PGA	2.5		2.5
Constant Wear Garment Stowage	1.0		1.0
Supports	(.4)		(.4)
TOTAL CREW SYSTEMS	471.0	-16.0	455.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEENVIRONMENTAL CONTROL SYSTEM

ITEM	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>ENVIRONMENTAL CONTROL SYSTEM</u>			
Pressure Suit Circuit	(88.3)		(88.3)
Subcontractor Comp., Heat Exch., Val. & Cont.	70.8		70.8
Ducting, Conn., Clamps, & Compr. Sel. Sw.	15.5		15.5
CO <sub>2</sub> Sensor	2.0		2.0
Water-Glycol Circuit	(74.8)		(74.8)
Subcontractor Res., Evap., Pump, Val. & Cont.	35.4		35.4
Water-Glycol	24.4		24.4
Plumbing, & Glycol Pump Sel. Sw.	15.0		15.0
Pressure & Temp. Control	(19.1)		(19.1)
Subcontractor Heat Exch., Blwr. Val. & Cont.	16.7		16.7
Ducting & Cabin Blower Sel. Sw.	2.4		2.4
Oxygen Supply System	(17.2)		(17.2)
Subcontractor Val. & Contr.	5.2		5.2
Plumbing	4.5		4.5
Oxygen Surge Tank	7.5		7.5
Water Supply System	(31.5)	(-4.0)	(27.5)
Subcontractor Potable & Waste Tanks	28.2	-4.0	24.2
Plumbing	3.3		3.3
Waste Management System	(22.4)		(22.4)
Subcontractor Common Items	(27.5)		(27.5)
Brackets, Plumbing, Elect. Wiring	13.0		13.0
Instrumentation	14.5		14.5
Propellant Temp. Contr. Sys. (Wiring)	(10.0)	(-10.0)	(0.0)
Supports	(11.0)		(11.0)
Electrical Wiring	(9.8)		(9.8)
Manual Controls - Push Pull	(3.6)		(3.6)
N <sub>2</sub> Purge System	(2.8)		(2.8)
TOTAL ENVIRONMENTAL CONTROL SYSTEM	318.0	-14.0	304.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEEARTH LANDING SYSTEM

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>EARTH LANDING SYSTEM</u>			
Parachute System	(521.5)		(521.5)
Drogue Chute System (Dual)	75.8		75.8
Main Cluster	375.6		375.6
Pilot Chute System	24.3		24.3
Sequence Control	8.5		8.5
Attach Provisions	37.3		37.3
Location Aids	(5.3)		(5.3)
Forward Heat Shield Release System	(52.5)		(52.5)
Drogue Disconnect Installation (Dual)	(9.6)		(9.6)
Electrical Pyrotechnic Initiation Provisions	(6.0)		(6.0)
Crushable Honeycomb - Impact Attenuation	(40.1)		(40.1)
TOTAL EARTH LANDING SYSTEM	635.0		635.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEINSTRUMENTATION

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>INSTRUMENTATION</u>			
Lower Equipment Bay	(81.1)	(-34.0)	(47.1)
PCM Unit No. 1	24.1		24.1
PCM Unit No. 2	23.0		23.0
PAM/FM/FM Package (GFE)	16.0	-16.0	
Tape Recorder	18.0	-18.0	
Remote Equipment	(41.0)		(41.0)
Sensors	35.0		35.0
TV Camera & Lens	4.5		4.5
TV Viewfinder	1.5		1.5
Right Hand Bay Forward	-	(+27.0)	(27.0)
Inflight Test System			
Comparators		+6.8	6.8
Power Supply		+3.2	3.2
Controls		+5.0	5.0
Misc. Electronics		+2.0	2.0
Chassis		+4.0	4.0
Harness		+5.0	5.0
Access Cable		+1.0	1.0
Aft Compartment	(9.0)	(-9.0)	-
Commutators (3) (GFE)	9.0	-9.0	
R & D Equipment	(260.0)	(-260.0)	-
Instrumentation	110.0	-110.0	
Wiring, Mounting, etc.	150.0	-150.0	
Electrical Provisions	(169.9)	(-20.0)	(149.9)
Inflight Test Electrical Provisions		+15.0	15.0
Data Distribution Panel	2.3		2.3
Wiring FQ PCM	2.0	-2.0	
Instrumentation Electrical Prov.	165.6	-33.7	131.9
Radiation Detection Provisions	-	+ .7	.7
TOTAL INSTRUMENTATION	561.0	-296.0	265.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEELECTRICAL POWER

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>ELECTRICAL POWER</u>			
Energy Source	(75.8)		(75.8)
Battery Re-Entry (2)	44.2		44.2
Battery - Post Landing (1)	22.1		22.1
Battery - Pyrotechnic - Installation	8.0		8.0
Battery Vent System	1.5		1.5
Power Conversion	(121.0)		(121.0)
Inverter (3) & Control	117.0		117.0
Battery Charger & Controls	4.0		4.0
Power Distribution & Control	(122.2)	(-6.0)	(116.2)
D-C Power Panel Assy.	7.6		7.6
A-C Power Box Assy.	10.5		10.5
Battery Circuit Breaker Panel	3.4		3.4
Lower Equipment Bay Panel	4.2		4.2
Terminal Distribution Panel (Bus)	9.6		9.6
Circuit Breaker Panel	4.7		4.7
Electrical Wiring	57.7	-6.0	51.7
Ground Power Provisions	4.5		4.5
Power Control Panel Connectors	3.0		3.0
Installation Provisions	10.0		10.0
Phase Correcting Capacitor	6.0		6.0
Inverter Bus Selection Control	1.0		1.0
Electrical Common Utility	(282.0)	(-9.0)	(273.0)
Electrical Trans. (Conn., Con., Sup.)	97.6	+9.0	106.6
Right Hand Circuit Breaker Panel	17.1		17.1
Left Hand Circuit Breaker Panel	10.9		10.9
Lighting Equipment	6.5		6.5
Lighting Wiring	2.5		2.5
Adapter Separation System Wiring	2.5		2.5
LES Separation System	18.1	-3.0	15.1
Circuit Utilization Package	6.3		6.3
Sequencers	39.1		39.1
Installation Provisions	15.3	-2.0	13.3
C/M to S/M Sep. Sys. Wire	10.2	-1.0	9.2
SPS Electrical Provisions - S/M	23.3	-4.0	19.3
RCS Electrical Provisions - S/M	14.1	-3.0	11.1
Booster S/C Separation Sequencer	5.0	-5.0	-
Fuse Box Assy.	6.0		6.0
Cryogenic System Wiring	7.5		7.5
TOTAL ELECTRICAL POWER	601.0	-15.0	586.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEREACTION CONTROL SYSTEM

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>REACTION CONTROL SYSTEM</u>			
Propellant System			
Oxidizer System	(37.2)		(37.2)
Tanks & Expulsion Devices	15.0		15.0
Plumbing, Fittings & Insulation	11.4		11.4
Valves & Regulators	10.3		10.3
Sensors	.5		.5
Fuel System	(36.3)		(36.3)
Tanks & Expulsion Devices	14.1		14.1
Plumbing & Regulators	11.4		11.4
Sensors	.5		.5
Valves & Regulators	10.3		10.3
Subtotal Propellant Systems	73.5		73.5
Pressure System			
Tanks (4500 psi)	9.5		9.5
Plumbing, Fittings & Insulation	4.8		4.8
Valves & Regulators	38.6		38.6
Sensors	2.5		2.5
Subtotal Pressure System	55.4		55.4
Engine System			
Engines	90.0		90.0
Nozzle Extension	42.0		42.0
Subtotal Engine System	132.0		132.0
Electrical Provisions			
Switching Panel	21.4		21.4
Wiring	17.3	-2.0	15.3
Subtotal Electrical Provisions	38.7	-2.0	36.7
Dumping System			
Valves & Supports	13.0		13.0
Control & Electrical Provisions	12.0		12.0
Plumbing & Fittings	5.0		5.0
Miscellaneous	2.4		2.4
Subtotal Dumping System	32.4		32.4
TOTAL REACTION CONTROL SYSTEM	332.0	-2.0	330.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULECOMMUNICATIONS

	AIRFRAME Oll 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>COMMUNICATIONS</u>			
Lower Bay	(238.0)	(+25.0)	(263.0)
C-Band Transponder	22.8		22.8
Unified S-Band	30.9		30.9
S-Band Power Amplifier	17.5		17.5
VHF FM Transmitter/HF Transceiver	15.4		15.4
VHF AM Trans. - Rec./VHF Rec. Bea.	15.1		15.1
Multiplexer	12.0		12.0
Spares	-	+19.0	19.0
Signal Conditioner	41.0		41.0
Recorder	25.4		25.4
Audio Center	8.0		8.0
Premodulation Processor	14.2		14.2
Central Timing Equipment	8.0		8.0
Up Data Link and Provisions	24.5		24.5
VHF-HF Diplexer	1.7		1.7
VHF-UHF Diplexer	1.5		1.5
S-Band P.A. Spare TWT	-	+1.5	1.5
S-Band P.A. Spare Pwr. Sup.	-	+4.5	4.5
Remote Equipment	(57.3)		(57.3)
VHF-HF Recovery Antenna & Transmission	11.4		11.4
C-Band Antenna & Transmission	11.7		11.7
2-KMC High Gain Antenna and Transmission	4.4		4.4
VHF-2 KMC Omn. Antenna, Transmission and Instl. Provisions	29.8		29.8
Electrical Provisions	(44.4)	(-2.0)	( 42.4)
Electrical Wiring	31.6	-2.0	29.6
Data Distribution Panel	1.5		1.5
Coax	5.2		5.2
Connectors	6.1		6.1
Supports	(.3)		( .3)
TOTAL COMMUNICATIONS	340.0	+23.0	363.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULECONTROLS & DISPLAYS

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>MAIN DISPLAY PANEL</u>			
Main Display Panel Control Station			
SCS Mode Select	5.5	-2.5	3.0
Delta Velocity	3.6	- .5	3.1
Flight Director Attitude Indicator	12.6	-1.5	11.1
Attitude Set and Gimbal Position Display	5.3	- .5	4.8
SPS Gimbal Actuator	.5		.5
Entry Monitoring Indicator	23.0		23.0
Launch Vehicle EDS C-1	4.7		4.7
Master Caution and Abort Lt.	.3		.3
IFTS Switch	.1		.1
Barometric Indicator Light	1.8	-1.7	.1
Event Timer	1.5		1.5
Mounting Panels	2.9	- .5	2.4
Rendezvous Radar Panel	-	+13.0	13.0
Subtotal Main Display Panel Control Station	61.8	+5.8	67.6
Main Display Panel Center Station			
Audio Panel	1.2		1.2
Abort Light	.2		.2
Reaction Control	8.5		8.5
GMT Clock	.8		.8
ECS Gages and Controls	6.6		6.6
Crew Safety Controls	1.6		1.6
High Gain Antenna Control	-	+2.5	2.5
G & N Computer Keyboard	20.5		20.5
Radiation Display	-	+1.4	1.4
Cryogenic	6.5	-2.3	4.2
Caution & Warning	4.8		4.8
S/M Temperature Controls	3.0	-3.0	
Mounting Panels	11.1	-1.0	10.1
Subtotal Main Display Panel Center Station	64.8	-2.4	62.4
Main Display Panel System Management Station			
Communications Control Panel	4.0		4.0
Master Caution Lights	.2		.2
Power Distribution	6.1		6.1
Fuel Cells Controls	4.7		4.7
Service Propulsion	8.9		8.9
IFTS Switch	.1		.1
Oxygen Warning	.1		.1
Mounting Panels	7.8		7.8
Subtotal Main Display Panel Sys. Manag. Sta.	31.9	- .4	31.5
TOTAL MAIN DISPLAY (to be brought forward)	158.5	+3.0	161.5

~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULECONTROLS AND DISPLAYS

ITEM	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
MAIN DISPLAY PANEL (Continued)			
Main Display Panel RH Console			
Bus Switches	5.7		5.7
Audio Panel	1.2		1.2
Lighting Control	1.6		1.6
Mounting Panel	2.8	-.8	2.0
Subtotal Main Display Panel RH Console	11.3	-.8	10.5
Main Display Panel LH Console			
Mission Sequence Controls	1.0		1.0
Lighting Control	1.6		1.6
Audio Panel	1.2		1.2
SCS Power Control	2.2		2.2
Mounting Panels	2.7	-.8	1.9
Subtotal Main Display Panel LH Console	8.7	-.8	7.9
Total Main Display this page	20.0	-1.6	18.4
Total Main Display forwarded from Page 59	158.5	+3.0	161.5
TOTAL MAIN DISPLAY (To be brought forward)	178.5	+1.4	179.9

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULECONTROLS AND DISPLAYS

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>REMOTE EQUIPMENT</u>			
Lower Equipment Bay			
Lighting Control Panel	1.2		1.2
G & N Controls and Displays			
Map and Data Viewer	7.7	+ .6	8.3
Display and Control - Navigator	22.9	-2.2	20.7
Display and Control - Computer	20.6		20.6
Subtotal Lower Equipment Bay	52.4	-1.6	50.8
Left Hand Forward Equipment Bay			
Clock	.8		.8
Event Timer	2.0		2.0
Mounting Panel	.3		.3
Subtotal Left Hand Forward Equipment	3.1		3.1
Crew Area Controls			
Manual Control - Rotation	10.0		10.0
Manual Control - Translational	7.7		7.7
Subtotal Crew Area Controls	17.7		17.7
Caution and Warning Detector	14.0		14.0
Subtotal Caution and Warning	14.0		14.0
Electrical Provisions			
Electrical Wiring	73.6	-24.8	48.8
SCS/G&N Display Junction Box	.7		.7
Subtotal Electrical Provisions	74.3	-24.8	49.5
TOTAL REMOTE EQUIPMENT	161.5	-26.4	135.1
TOTAL MAIN DISPLAY PANEL	178.5	+1.4	179.9
TOTAL CONTROLS AND DISPLAYS	340.0	-25.0	315.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEUSEFUL LOAD

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>CREW SYSTEMS</u>			
Government Furnished Equipment			
Crew (50, 70, 90)	(528.0)		(528.0)
Space Suit Assy (SSA)	(131.6)	(+60.0)	(191.6)
Pressure Garment Assy (PGA)			
Torso Assy	73.9		73.9
Helmet Assy	25.3		25.3
Thermal Assy	22.8		22.8
Constant Wear Garment	2.6		2.6
Urine and Feces Assy	4.6		4.6
Portable Life Support System			
Back Pack			
System Equipment		+40.6	40.6
LiOH Cartridge (Charged)		+3.5	3.5
Water (Initial Charge)		+5.0	5.0
Oxygen (Initial Charge)		+ .9	.9
Emergency Oxygen		+5.2	5.2
Communications, Elect. Monitoring & Tel			
Suit Mounted (3)	2.4		2.4
Back Pack Mounted		+4.8	4.8
Constant Wear Garments (6)	(5.3)		(5.3)
Instrument Assy. - Biomedical Sensors			
& Preampl.	(2.0)		(2.0)
Dosimeter - Radiation, Personal	(11.8)		(11.8)
Whole Body Tissue Dosimeter	9.0		9.0
Extremity Dosimeter	1.1		1.1
Charger Reader	1.7		1.7
Food & Food Packaging	(81.5)		(81.5)
Food	67.5		67.5
Food Packaging	12.5		12.5
Water Probe	1.5		1.5
Medical Equipment	(5.5)		(5.5)
Medical Kit - Dressing, Emerg.	.4		.4
Medical Kit - Medication, Emerg.	3.7		3.7
Instrument Set - Physiological Monitor	1.4		1.4

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	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>CREW SYSTEMS (Cont'd)</u>			
Survival Kit (Contents) (3)	(67.2)		(67.2)
One Man Life Raft	18.0		18.0
Sea Dye Marker (24 Hrs.)	6.4		6.4
Water Container	1.2		1.2
Water	18.0		18.0
Desalting Kit	2.9		2.9
Signal Mirror	1.2		1.2
Transceiver	14.0		14.0
Sunglasses	.2		.2
First Aid Kit	.6		.6
Flare Set	.8		.8
(The above items are NAA/NASA definitions.)			
Knife-Survival	1.1		1.1
Life Vests	.8		.8
Balloon Kits	.6		.6
Light Assy - Survival	.4		.4
Light Assy - Location C/M	1.0		1.0
(The above items are NAA definitions)			
ARC Strobs Light	-		-
Compass	-		-
Sparky Lighter	-		-
Nylon Cord	-		-
Sewing Kit	-		-
Fishing Kit	-		-
Whistle	-		-
Machete	-		-
(The above items listed by NASA in Ltr. 3056 MA (5 March 1964) are not being carried weightwise until definite requirement is established.)			
Subtotal Government Furnished Equipment	832.9	+60.0	892.9

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEUSEFUL LOAD

	AIRFRAME Oll 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>CREW SYSTEMS (Cont'd.)</u>			
NAA-S&ID Furnished Equipment			
Survival Kit Containers	(10.5)		(10.5)
Crew Accessories	(24.5)		(24.5)
Flight Kit Assy (2)	12.0		12.0
Tool Set - Inflight Maint.	3.5		3.5
Light Assy. - Portable	3.0		3.0
Crew Optics	6.0		6.0
Crewman Equipment	(1.0)		(1.0)
Belt Assy - Inflight Tool Set	1.0		1.0
Food Associated Equipment	(2.0)		( 2.0)
Mouthpiece - Food Personal	2.0		2.0
Personal Communications (3)	(5.1)		(5.1)
Bump Helmet	3.9		3.9
Electronics	1.2		1.2
Personal Hygiene Equipment	(15.2)	(-4.5)	(10.7)
Cleansing Pad Set	6.0		6.0
Dentifrice Set - Ingestible	.1		.1
Shaver Assy. (1)	.8		.8
Towel Assy. - Utility	.8		.8
Storage Container - Personal Hygiene	7.5	-4.5	3.0
Medical Kit Container	(5.5)	(-1.5)	(4.0)
Waste Management	(1.5)		(1.5)
Bag Set - Fecal/Emesis	1.5		1.5
Supports	(.8)		(.8)
Subtotal NAA-S&ID Furnished Equipment	66.1	-6.0	60.1
TOTAL CREW SYSTEMS	899.0	+54.0	953.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEUSEFUL LOAD

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>REACTION CONTROL</u>			
Usable Propellant	(225.0)		(225.0)
Residual Propellant	(44.0)		(44.0)
Trapped - System	30.8		30.8
Mixture Ratio	2.7		2.7
Expulsion Efficiency	7.8		7.8
Loading Tolerance	2.7		2.7
RCS Helium	(1.0)		(1.0)
TOTAL REACTION CONTROL	270.0		270.0
<u>ENVIRONMENTAL CONTROL</u>			
Lithium Hydroxide	104.0		104.0
Activated Charcoal	3.8		3.8
Containers for LiOH and Charcoal	12.0		12.0
Oxygen - Re-Entry	3.7		3.7
Water-Earth Orbit Cooling & Drinking	3.5		3.5
Water-Boost Cooling	4.0		4.0
Water-Emergency Re-Entry Cooling	6.0		6.0
Chemical Disinfectant	4.0		4.0
TOTAL ENVIRONMENTAL CONTROL	141.0		141.0
SCIENTIFIC EQUIPMENT	0.0	+80.0	+80.0
TOTAL This page	411.0	+80.0	491.0
TOTAL CREW SYSTEM (Brought forward from Page 64)	899.0	+54.0	953.0
TOTAL USEFUL LOAD	1310.0	+134.0	1444.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULESUMMARY

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>WEIGHT EMPTY</u>	(7695)	(+195)	(7890)
Structure	2305	+75	2380
Environmental Control	168	-80	88
Instrumentation	130	+3	133
Electrical Power	1436	+13	1449
Propulsion	3079		3079
Reaction Control System	576		576
Communications & Rendezvous Radar	1	+184	185
<u>USEFUL LOAD</u>	(2230)		(2230)
Reaction Control	838		838
Electrical Power	503		503
Environmental Control	208		208
Propulsion	681		681
BURNOUT WEIGHT	9925	+195	10120
MAIN PROPELLANT	-	-	36945
GROSS WEIGHT	-	-	47065

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULESTRUCTURE

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>STRUCTURE</u>			
Basic Body Structure	(1680)	(+9)	(1689)
Honeycomb Panels	585		585
Frames and Rings	6		6
Access Doors	16		16
Fittings and Attach Parts	48		48
Radial Beams	368	+5	373
Internal Partitions	37		37
Forward Bulkhead	163	+4	167
Aft Bulkhead	327		327
RCS Panels	130		130
Secondary Structure	(135)	(+50)	(185)
Tank Support Shelf	29		29
Engine Support Structure	54		54
Antenna Support Structure		+50	50
Aft Heat Shield	52		52
Insulation	(294)	(+5)	(299)
Separation Provisions and Attachments	(16)		(16)
Fairing - C/M to S/M	(150)	(+11)	(161)
Miscellaneous	(30)		(30)
TOTAL STRUCTURE	2305	+75	2380

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEENVIRONMENTAL CONTROL SYSTEM

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>ENVIRONMENTAL CONTROL SYSTEM</u>			
Water-Glycol Circuit	(73.6)		(73.6)
Subcontractor Valves & Controls	10.5		10.5
Plumbing and Hardware	20.5		20.5
Water-Glycol	10.0		10.0
Space Radiator	32.6		32.6
Water Supply System	(6.6)		(6.6)
Plumbing and Hardware	6.6		6.6
Oxygen Supply System	(3.0)		(3.0)
Plumbing and Supports	3.0		3.0
Common Items	(4.8)		(4.8)
Supports (S&ID)	3.5		3.5
Wiring	1.3		1.3
Propellant Temperature Control System	(80.0)	(-80.0)	(0.0)
Hardware	70.0	-70.0	
Wiring	10.0	-10.0	
TOTAL ENVIRONMENTAL CONTROL SYSTEM	168.0	-80.0	88.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEINSTRUMENTATION

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>INSTRUMENTATION</u>			
Instrumentation	(29.0)		(29.0)
Electrical Provisions	(96.0)		(96.0)
Supports	(5.0)		(5.0)
Radiation Detection		+3.0	(3.0)
TOTAL INSTRUMENTATION	130.0	+3.0	133.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEELECTRICAL POWER

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>ELECTRICAL POWER</u>			
Fuel Cell Power System	(1224.3)		(1224.3)
Fuel Cell Power Pack (Incl. Mnt. Instr.)	738.9		738.9
Intermodular - Radiation Plumbing	47.5		47.5
Fuel Cell Module Mount Attach	1.1		1.1
Fuel Cell H <sub>2</sub> System			
Subcontractor Components	151.6		151.6
Plumbing and Valves	5.7		5.7
Fuel Cell and ECS O <sub>2</sub> System			
Subcontractor Components	176.8		176.8
Plumbing and Valves and Supports	32.3		32.3
Water Glycol - Fuel Cell Heat Trans. Sys.	7.0		7.0
Elect. Wiring - Cryogenic Gas	8.7		8.7
Space Radiator	40.5		40.5
Fuel Cell Module Stabilization Webs.	2.9		2.9
Fuel Cell Plumbing Supports	6.0		6.0
Valve Module Control Box (Cryogenic Gas)	5.3		5.3
Power Distribution	(88.9)	(+7.0)	(95.9)
Electrical Wiring	58.1	+7.0	65.1
Power Distribution Box	30.8		30.8
Electrical Common Utility	(122.8)	(+6.0)	(128.8)
Electrical Transmission (Comm & Supts)	46.6	+1.0	47.6
Sequencer	28.0		28.0
Adapter Separation System Wiring	1.4		1.4
C/M to S/M Separation System Wiring	2.5		2.5
Pryotechnic Initiation	12.0		12.0
Provisions	9.9		9.9
LES Separation Sys. Wiring & Hardware	7.4		7.4
Shape Charge Assy.	15.0	+5.0	20.0
TOTAL ELECTRICAL POWER	1436.0	+13.0	1449.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEMAIN PROPULSION

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>MAIN PROPULSION</u>			
Propellant System			
Oxidizer System	(779.3)		(779.3)
Tanks & Doors	557.0		557.0
Skirts	59.8		59.8
Plumbing, Fittings & Insulation	53.0		53.0
Valves	4.5		4.5
Quantity Indication	25.5		25.5
Mixture Ratio Control	14.0		14.0
Supports - Plumbing & Equipment	43.5		43.5
Retention Reservoir	22.0		22.0
Fuel System	(615.7)		(615.7)
Tanks & Doors	458.0		458.0
Skirts	33.2		33.2
Plumbing, Fittings & Insulation	42.0		42.0
Valves	4.5		4.5
Quantity Indication	25.5		25.5
Supports - Plumbing & Equipment	31.5		31.5
Retention Reservoir	21.0		21.0
Subtotal Propellant System	1395.0		1395.0
Pressure System			
Tanks (4400 psi)	784.0		784.0
Tank Supports	30.0		30.0
Plumbing, Fittings & Insulation	24.0		24.0
Valves, Regulators & Heat Exchanger	49.0		49.0
Supports - Plumbing & Equipment	38.0		38.0
Subtotal Pressure System	925.0		925.0
Engine System			
Engine	702.0		702.0
Closeouts - Throats to S/M	25.0		25.0
Subtotal Engine System	727.0		727.0
Electrical Wiring	32.0		32.0
TOTAL MAIN PROPULSION SYSTEM	3079.0		3079.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEREACTION CONTROL

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>REACTION CONTROL SYSTEM</u>			
Propellant System	(92.1)		(92.1)
Oxidizer System			
Tanks & Expulsion Devices	34.4		34.4
Plumbing, Fittings & Insulation	8.5		8.5
Valves & Regulators	12.0		12.0
Sensors	3.0		3.0
Supports	18.2		18.2
Quantity Gaging	16.0		16.0
Fuel System	(89.3)		(89.3)
Tanks & Expulsion Devices	31.6		31.6
Plumbing, Fittings & Insulation	8.5		8.5
Valves & Regulators	12.0		12.0
Sensors	3.0		3.0
Supports	18.2		18.2
Quantity Gaging	16.0		16.0
Subtotal Propellant Systems	181.4		181.4
Pressure System			
Tanks (4500 psi)	19.0		19.0
Plumbing, Fittings & Insulation	6.0		6.0
Valves & Regulators	76.0		76.0
Sensors	7.0		7.0
Supports	20.0		20.0
Subtotal Pressure System	128.0		128.0
Engine System			
Engines	75.2		75.2
Reflectors & Insulation	80.0		80.0
Subtotal Engine System	155.2		155.2
Structural Provisions	80.0		80.0
Electrical Wiring	31.4		31.4
TOTAL REACTION CONTROL SYSTEM	576.0		576.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULECOMMUNICATIONS & RENDEZVOUS RADAR

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>COMMUNICATIONS &amp; RENDEZVOUS RADAR</u>			
Communications			
Remote Equipment		(+40.0)	(+40.0)
Gimbal - High Gain Antenna		+12.2	12.2
Earth Sensor - High Gain Antenna		+12.0	12.0
High Gain Antenna		+4.8	4.8
Locking Provisions - High Gain Antenna		+3.0	3.0
Boom - High Gain Antenna		+8.0	8.0
Electrical Provisions	(1.0)	(+23.0)	(24.0)
Wiring - Common Utility	1.0	+13.0	14.0
Coax & Connectors - High Gain Antenna		+10.0	10.0
Supports		(+1.0)	(1.0)
Subtotal Communications	1.0	+64.0	65.0
Rendezvous Radar			
Rendezvous Equipment		(+69.8)	(69.8)
Radar Package		+30.0	30.0
X-Band Dish Ant., Trans. & Sup.		+17.8	17.8
Antenna Boom		+10.0	10.0
Antenna Actuation Mechanism		+10.0	10.0
Diplexer		+2.0	2.0
Transponder Equipment		(+28.6)	(28.6)
Transponder		+10.0	10.0
X-Band Flush Mntd. Omni Ant. (3)		+3.0	3.0
X-Band Trans. & Supports		+12.6	12.6
X-Band Power Divider		+1.0	1.0
Diplexer		+2.0	2.0
Supports & Cooling Provisions		(+15.6)	(15.6)
Rendezvous Equipment		+9.6	9.6
Transponder Equipment		+6.0	6.0
Electrical Provisions		(+6.0)	(6.0)
Rendezvous Equipment		+3.0	3.0
Transponder Equipment		+3.0	3.0
Subtotal Rendezvous Radar		120.0	120.0
TOTAL COMMUNICATION AND RENDEZVOUS RADAR	1.0	+184.0	185.0

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	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>REACTION CONTROL</u>			
RCS Propellant			
Usable	790.0		790.0
Residual			
Trapped System	4.0		4.0
Mixture Ratio	9.0		9.0
Expulsion Efficiency	24.0		24.0
Loading Tolerance	8.0		8.0
RCS Helium	3.0		3.0
TOTAL REACTION CONTROL	838.0		838.0
<u>ELECTRICAL POWER (Normal Mission)</u>			
Hydrogen - Supercritical Gas	(58.5)		(58.5)
Usable (Electrochemical Incl. Tolerance)	46.0		46.0
Unusable (Residual & Instrument Error)	3.2		3.2
Emergency Provisions	4.7		4.7
Expend (Leakage & Purge)	4.6		4.6
Oxygen - Supercritical Gas	(444.5)		(444.5)
Usable (Electrochemical Incl. Tolerance)	377.0		377.0
Unusable (Residual & Instrument Error)	17.5		17.5
Emergency Provisions	44.0		44.0
Expend (Leakage & Purge)	6.0		6.0
TOTAL ELECTRICAL POWER	503.0		503.0
<u>ENVIRONMENTAL CONTROL (Normal Mission)</u>			
Oxygen - Supercritical Gas			
Usable (Metabolic)	76.5		76.5
Unusable (Residual & Instrument Error)	9.1		9.1
Emergency Provisions	25.3		25.3
Expend (Leakage, LEM, PLSS, Repress.)	97.1		97.1
TOTAL ENVIRONMENTAL CONTROL	208.0		208.0
<u>PROPULSION</u>			
Main Propulsion Helium	(99.0)		(99.0)
Main Propellant Residuals	(582.0)		(582.0)
Trapped - System	225.0		225.0
Trapped - Engine	67.0		67.0
Mixture Ratio Tolerance	100.0		100.0
Loading Tolerance	190.0		190.0
TOTAL PROPULSION	681.0		681.0
TOTAL USEFUL LOAD (Less Main Propellant)	2230.0		2230.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTLAUNCH ESCAPE SYSTEMSUMMARY

	AIRFRAME O11 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>LAUNCH ESCAPE SYSTEM</u>			
Structure	(1239)		(1239)
Tower	301		301
Escape Motor Skirt	208		208
Canard	560		560
Nose Cone	35		35
Attaching Parts	14		14
Tower Insulation	111		111
Skirt Insulation	10		10
Separation Provisions	(13)		(13)
Ballast	(719)	(-80)	(639)
Propulsion	(5349)		(5349)
Escape Motor	4774		4774
Jettison Motor	434		434
Jettison Motor Skirt	92		92
Pitch Control Motor	49		49
Electrical Power	(85)		(85)
C/M Boost Protection Cover		(+185)	(185)
TOTAL LAUNCH ESCAPE SYSTEM	7405	+105	7510

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTADAPTERSUMMARY

	AIRFRAME 011 6-1-64	CHANGE TO LOR	LOR SPACECRAFT 6-1-64
<u>ADAPTER</u>			
Structure	(865)	(+2540)	(3405)
Basic Body Structure			
Honeycomb Panels	564	+1871	2435
Longerons	12	+34	46
Frames & Rings	78	+228	306
Access Doors	22	+28	50
Fittings & Attachings Parts	23	+53	76
Secondary Structure			
LEM Supports		+32	32
Insulation		+20	20
Separation Provisions & Attach	156	+204	360
Miscellaneous	10	+70	80
Electrical Provisions	(20)	(+50)	(70)
TOTAL ADAPTER	885	+2590	3475

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